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Retransmission of Hydrometric  
Data in Canada  
SR 28190

Applied Hydrology Division  
Department of the Environment  
Ottawa, Ontario, Canada  
K1A 0E7

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Quarterly Report for period October-December 1975

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12. Sponsoring Agency Name and Address Canada Centre for Remote Sensing Department of Energy, Mines & Resources 2464 Sheffield Road Ottawa, Ontario, K1A 0E4		13. Key Words (Selected by Principal Investigator) Landsat, Data Retransmission, Water Resources Data
14. Supplementary Notes  Prepared by I.A. Reid and R.A. Halliday		
15. Abstract  Data Collection Platforms have been installed at 17 sites in remote areas of Canada for transmittal of water level and other water resources data. The near real-time data are used for water management purposes. The system has met all requirements and the suitability of satellite retransmission has been demonstrated.		

## I. Introduction

The Water Survey of Canada operates over 2,400 hydrometric stations at which water level data are collected. Because of the isolated locations of many of these stations, it is not economically feasible to telemeter data from the site by conventional means. For this reason an experiment was conducted which involved transmitting data from nine sites by means of Landsat 1. The technical suitability of the system was demonstrated and, for this reason, it was decided to implement a larger network. In this way, it should be possible to determine the benefits and costs that would be associated with an operational system.

## II. Techniques

Data Collection Platforms have now been installed at 17 sites and an additional 11 DCPs will be installed in 1976. The sites (Figure 1, Table 1) were selected on the basis of real-time data needs for water management purposes. Water level data are transmitted from all sites while additional parameters, mainly meteorological data, are transmitted from some sites.

Water levels are sensed at Water Survey of Canada gauging stations by a float and pulley or by servomanometers that sense the static pressure in a nitrogen purge system. Water level is usually recorded on a strip chart recorder. At those stations where DCPs are installed, an analogue to digital shaft position encoder (the Stevens Memomark II) is used to encode and store 16 bits (4 BCD digits) of water level data for transmittal by the DCP.

Precipitation data are obtained using a Fischer and Porter weighing type precipitation gauge. The gauge can be equipped with a Telekit for telemetering of data. The gauge is connected to a serial digital interface designed by the Atmospheric Environment Service, (AES) Department of the Environment. The interface is known as a Hydrometeorological Automatic Recording and Telemetering System (HARTS).

Air temperatures are sensed by a platinum resistance bulb thermometer. This data can also be processed by the HARTS interface.

The data transmitted by the DCPs are processed by NASA then sent to Canada in two ways. The first is by land line to the Canada Centre for Remote Sensing in Ottawa. The data usually arrive shortly after each orbit of the spacecraft. At CCRS the data are recorded simultaneously on a teletype hard copier and on magnetic tape. A software data retrieval system sorts the user platforms, reformats the data into engineering units and stores individual user files on disk. The user may then access his data file, usually daily, using either a teletype or telex remote terminal.

FIGURE 1

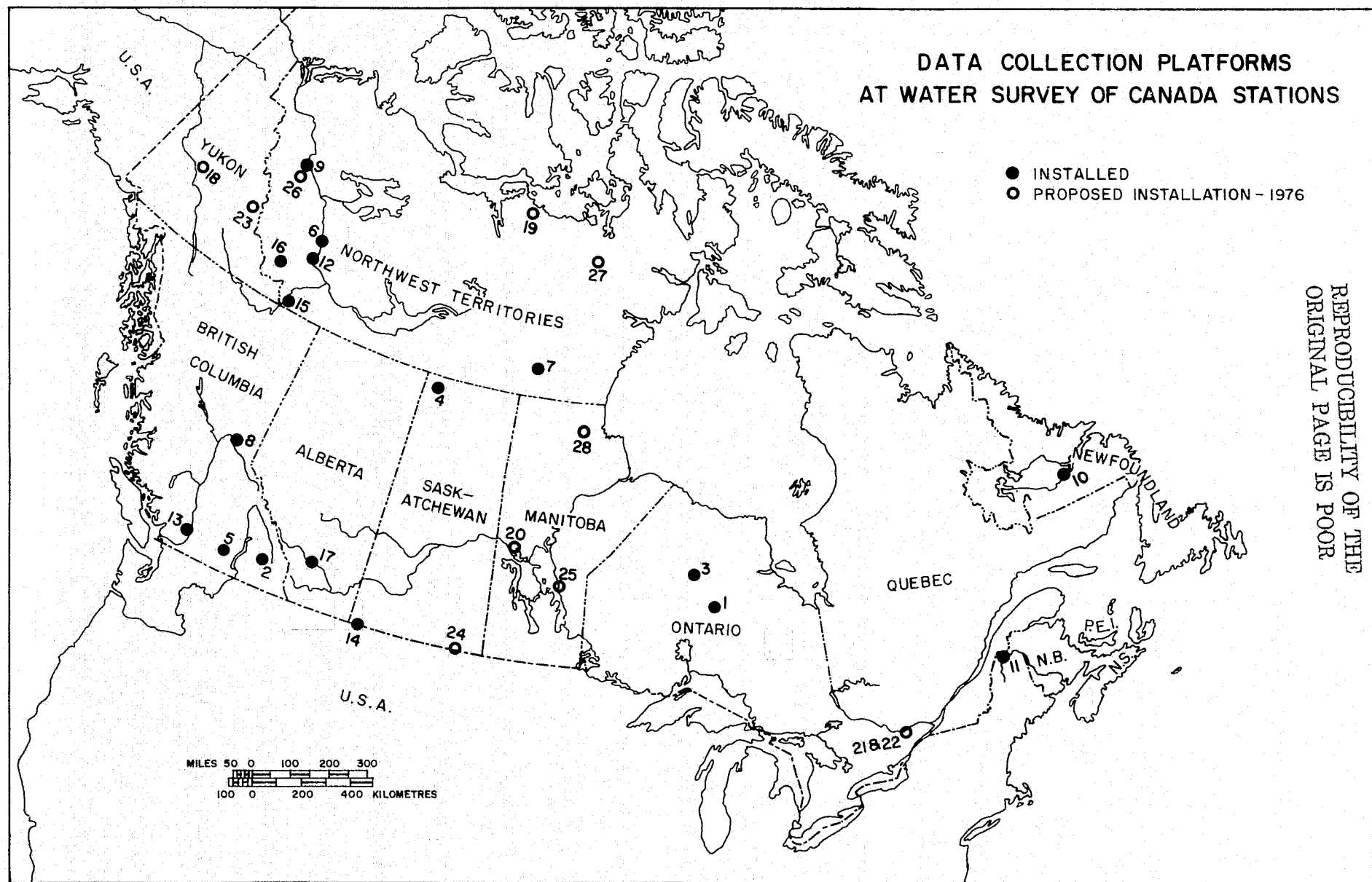


TABLE 1

LOCATION OF DATA COLLECTION PLATFORMS

DECEMBER 75

<u>INSTALLED HYDROMETRIC STATIONS</u>	<u>DATE INSTALLED</u>	<u>DCP</u>	<u>LAT.</u>	<u>LONG.</u>
1) Albany River above Nottik Island	Jan 13, 73	6102	51° 38'	86° 24'
2) Carney Creek below Pambrun Creek	Mar 25, 75	6126	50° 10'	116° 35'
3) Winisk River at Kanuchuan Rapids	Sept 27, 74	6137	52° 58'	87° 42'
4) Lake Athabasca at Crackingstone Point	Sept 19, 72	6150	59° 23'	108° 53'
5) Snow course #5A Mission Creek	Oct 31, 75	6232	49° 57'	118° 55'
6) Mackenzie River near Wrigley	June 7, 73	6260	63° 16'	123° 36'
7) Kazan River at Outlet of Ennadai Lake	Sept 19, 72	6353	61° 16'	100° 58'
8) McGregor River at Lower Canyon	May 23, 73	6354	54° 14'	121° 40'
9) Mackenzie River at Sans Sault Rapids	May 31, 73	6366	65° 46'	128° 45'
10) Churchill River at Muskrat Falls	Aug 7, 75	6502	53° 15'	60° 47'
11) St. Francis River at Outlet of Glacier Lake	Aug 13, 75	6504	47° 12'	68° 57'
12) Root River near the Mouth	July 15, 75	6512	62° 29'	123° 26'
13) Nahatlatch River below Tachewana Creek	Oct 20, 75	6514	49° 57'	121° 52'
14) Battle Creek at International Boundary	Oct 22, 75	6541	49° 00'	109° 25'
15) Liard River at Ford Liard	July 17, 75	6547	60° 15'	123° 29'
16) South Nahanni River above Virginia Falls	July 15, 75	6572	61° 38'	125° 48'
17) Bow River below Carseland Dam	Oct 27, 75	6574	50° 50'	113° 25'

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18) Pelly River at Pelly Crossing	6501	62° 50'	136° 35'
19) Ellice River near the Mouth	6507	67° 42'	104° 08'
20) Moose River near Moose Lake	6511	53° 38'	100° 19'
21) Rideau River at Ottawa Test Site	6517	45° 23'	75° 42'
22) Rideau River at Ottawa Test Site	6521	45° 23'	75° 42'
23) South MacMillan River at Mile 249 Canal Road	6522	62° 55'	130° 32'
24) Long Creek at Western Crossing of International Crossing	6524	49° 00'	103° 21'
25) Lake Winnipeg at Berens River	6527	52° 21'	97° 00'
26) Mountain River below Cambrian Creek	6542	65° 14'	128° 34'
27) Back River below Deep Rose Lake	6544	66° 05'	96° 30'
28) Seal River below Great Island	6571	58° 54'	96° 17'

The data are also received in card and printout format from NASA about 10 to 14 days after transmittal by the DCP. The data are delivered to the Canadian Embassy in Washington, D.C. then carried by diplomatic bag to the Department of External Affairs in Ottawa. External Affairs then mails the data. The cards are run in computer programs that sort the data and perform the conversion to engineering units. Data produced in this way are used to generate statistics on DCP performance, for quality checks and for archival purposes.

### III. Accomplishments

Platform 6232 along with the HARTS serial digital interface was moved from Nahatlatch River below Tachewana Creek on October 20, 1975 and installed at the snow course No. 5A Mission Creek Site on October 31, 1975. The HARTS unit stores accumulated precipitation, stage and air temperature. In addition, John Old of the Department of the Environment, Atmospheric Environment Service installed a snow pillow at the site. A Ball Model EX410 differential pressure transducer having an analogue voltage output is connected directly to the DCP. This platform is operated in co-operation with the Government of British Columbia and provides data used in controlling the inflow into Lake Okanagan for flood control purposes. Data from this site would not be available on a real-time basis without satellite telemetry.

Platform 6514 was installed at Nahatlatch River below Tachewana Creek on October 21, 1975 replacing 6232. The electromagnetic water velocity meter installed at the Nahatlatch site was disbanded as the probe was repeatedly knocked out of position by debris. Incorrect readings occur when the probe is not orientated correctly.

Platform 6541 was installed on Battle Creek at the International Boundary, an international gauging station, on October 22, 1975. The site is in an isolated part of the Cypress Hills and access is difficult, particularly during poor weather conditions. Water level data transmitted by the DCP will be used in computing the 10 day apportionment of flow between Canada and the United States.

Platform 6574 was installed on the Bow River below Carseland Dam on October 27, 1975. This location is used mainly as a test site. Many of the other DCPs have been tested at this location prior to installation at more remote sites. Water levels and DCP battery voltage data are transmitted. The charge on the two Union Carbide No. 564 rechargeable alkaline batteries is maintained by a 3.5 W solar panel.

Table 2 is a summary of the data retransmitted for cycles 60 to 69 that occurred from July 23 to December 19, 1975. During this period slightly over 17,000 messages were processed from 26 platforms. Many of the platforms show transmissions for only a short period as they were being tested in preparation for installation at the sites shown in Table 1. Platform 6527 failed after sending 15 messages and Platform 6571 did not transmit. These platforms are being sent back to the manufacturer for inspection and repair.

#### IV. Significant Results

The project continues to demonstrate the feasibility of transmitting hydrometric data to polar orbiting spacecraft and using these data on a quasi-operational basis.

The implementation of the Alaska receive site in December had a significant impact on the Canadian experiment as the number of transmissions now received from some northern sites has increased substantially. More important, data are now received on as many as 11 orbits each day.

#### V. Publications

Use of Satellites in Data Retransmission by R.A. Halliday for World Meteorological Organization (WMO) Casebook on Hydrological Network Design Practise November, 1975 - invited paper.

Some Operational Uses of Satellite Retransmission in Canada by R.A. Halliday and I.A. Reid for Tenth International Symposium on Remote Sensing of Environment October 6-10, 1975, Ann Arbor, Michigan, U.S.A. - invited paper.

#### VI. Problems

Several problems such as availability of connectors were encountered in getting the Ball Brothers DCPs into operation. This resulted in delays in installing several DCPs.

It seems likely that DCP 6354 may have failed. This is one of the original General Electric units that has operated almost continuously for three years without failure.

#### VII. Data Quality and Delivery

Examination of a random sample of about a week of messages revealed that it takes from a few minutes to several hours from the time the messages are transmitted by a DCP to the time the messages are received by dedicated phone line at the Canada Centre for Remote Sensing, Ottawa. Except for possible emergency situations, this time delay does not degrade the usefulness of Landsat. The hard copy in card form arrives about 10 to 14 days after the messages have been transmitted. Again this time delay does not degrade the

TABLE 2

## SUMMARY OF RETRANSMITTED DATA - JULY 23 to DECEMBER 19, 1975

Daily Mean Transmissions per cycle for cycles 60 to 69 (Landsat-1)  
(Transmissions received simultaneously at two or more  
sites are counted only once.)

Platform	60	61	62	63	64	65	66	67	68	69	Daily		Total
											Max	Min*	
6102	7	7	7	8	8	7	7	7	8	8	11	1	1319
6126	4	4	4	3	4	4	4	4	4	4	7	1	701
6137	15	14	15	15	14	13	13	13	12	9	18	2	2343
6150	14	14	14	14	14	14	14	12	12	18	26	7	2530
6232	7	6	6	6	6	6	6	9	8	10	15	4	1179
6260	-	-	9	11	10	11	10	9	9	-	14	3	1007
6353	15	15	15	14	13	12	8	-	11	19	32	5	1787
6354	7	-	-	-	-	7	-	-	-	-	19	6	79
6366	8	7	7	8	7	10	6	5	-	-	10	1	923
6501	-	-	-	8	8	-	-	-	-	-	12	2	32
6502	8	9	8	9	9	-	9	8	8	6	13	1	1326
6504	-	1	10	11	9	10	9	9	12	12	16	1	1356
6507	-	-	-	5	-	-	-	9	-	-	15	2	60
6511	-	-	-	-	-	12	-	-	-	-	14	9	23
6512	-	4	5	6	5	5	4	4	-	-	9	1	530
6514	-	-	-	-	14	-	5	3	4	5	14	1	294
6517	-	-	-	-	3	-	-	-	-	-	5	1	17
6521	-	-	-	-	-	-	3	2	-	-	4	2	12
6522	-	-	-	-	-	12	-	-	-	-	13	10	23
6524	-	-	-	-	10	8	-	-	-	-	11	8	27
6527	-	-	-	-	-	-	-	3	-	-	6	1	15
6541	-	-	-	11	-	-	4	3	4	4	16	1	262
6542	-	-	-	-	-	-	-	3	-	-	3	3	9
6544	-	-	-	-	10	-	-	-	-	-	11	7	39
6547	-	2	2	2	2	2	2	-	-	-	4	1	193
6571	-	-	-	-	-	-	-	-	-	-	-	-	-
6572	-	2	5	5	5	5	5	4	4	-	8	1	553
6574	-	-	-	-	11	-	-	9	10	14	17	1	559
													17198

\* The minimum daily number of transmissions do not necessarily reflect the true minimum as the DCP could be turned off for part of the day the minimum value occurred.

usefulness of Landsat.

Only quality 7 data are received but this is all that is required. (About 98% of all data is quality 7.)

#### VIII. Recommendations

None at this time.

#### IX. Conclusions

Results to this time have demonstrated the suitability of satellite retransmission as a means of obtaining near real-time data from remote areas of Canada. Capital costs of the equipment installed at a gauging station are reasonable and indications are that the DCPs do not require much maintenance.

The potential impact of this technology on water resources data gathering activities is considerable. More work with quasi-operational programs is needed to determine the benefits precisely.